# Residential Carcinogen Exposure (childhood through adulthood) - ADEQ DRAFT SRLs

10/5/2005

$$C(mg/kg) = \frac{TR \times AT_c}{EF_r \left[ \left( \frac{IFS_{adj} \times CSF_o}{10^6 mg/kg} \right) + \left( \frac{SFS_{adj} \times ABS \times CSF_o}{10^6 mg/kg} \right) + \left( \frac{InhF_{adj} \times CSF_i}{VF_s^a} \right) \right]}$$

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{(ED_r - ED_c) \times IRS_a}{BW_a}$$

**Age-adjusted Ingestion Factor, (mg-yr)/(kg-d)**

$$SFS_{adj} = \frac{ED_c \times AF \times SA_c}{BW_c} + \frac{(ED_r - Ed_c) \times AF \times SA_a}{BW_a}$$

**Age-adjusted Skin Contact Factor, (mg-yr)/(kg-d)**

$$InhF_{adj} = \frac{ED_c \times IRA_c}{BW_c} + \frac{(ED_r - ED_c) \times IRA_a}{BW_a}$$

**Age-adjusted Inhalation Factor, ($m_3$-yr)/(kg-d)**

$$VF_s(m^3/kg) = (Q/C) \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4}(m^2/cm^2)$$

**Chemical-specific Volatilization Factor for volatile chemicals only**

$$PEF(m^3/kg) = Q/C \times \frac{3600s/h}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

**Particulte Emission Factor (replaces $VF_s$ for non-volatile chemicals)**

| | | Old Default | New Default |
|---|---|---|---|
| $CSF_o$, Cancer slope factor oral, $(mg/kg\text{-}d)^{-1}$ | | see database | |
| $CSF_i$, Cancer slope factor inhaled $(mg/kg\text{-}d)^{-1}$ | | see database | |
| TR, Target cancer risk | | **$10^{-5}$** | **$10^{-6}$** |
| $Bw_a$, Body weight - adult, kg | | 70 | 70 |
| $BW_c$, Body weight - child, kg | | 15 | 15 |
| $AT_c$, Averaging time for carcinogens, d | | 25,550 | 25,550 |
| $SA_a$, Exposed surface area of adult for soil/dust | | **5,000** | **5,700** |
| $SA_c$, Exposed surface area - child | | **2,000** | **2,800** |
| $AF_a$, Soil Adherence factor - adult, $(mg/cm^2)$ | | **0.2** | **0.07** |
| $AF_c$, Soil Adherence factor, child for soil, $(mg/cm^2)$ | | 0.2 | 0.2 |
| ABS, Skin absorption factor - semi-volatile organics | | 0.1 | 0.1 |
| (unitless) | – volatile organics | **0.1** | **none** |
| | – inorganics | **0.01** | **none** |
| $IRA_a$, Inhalation rate - adult, $(m^3/d)$ | | 20 | 20 |
| $IRA_c$, Inhalation rate - child, (m3/d) | | 10 | 10 |
| $IRS_a$, Soil ingestion - adult, (mg/day) | | **100** | **50** |
| $IRS_c$, Soil ingestion - child, (mg/day) | | 200 | 200 |
| $EF_r$, Exposure frequency - residential, (d/yr) | | 350 | 350 |
| $ED_r$, Exposure duration - residential (years) | | 30 | 30 |
| $ED_c$, Exposure duration - child, (years) | | 6 | 6 |
| $IFS_{adj}$ Age-adjusted soil ingestion factor, (mg-yr)/(kg-d) | | 114 | 114 |
| $SFS_{adj}$, Age-adjusted soil dermal contact factor, (mg-yr)/(kg-d) | | **503** | **361** |
| $InhF_{adj}$, Age-adjusted air inhalation factor, $(m^3\text{-yr})/(kg\text{-}d)$ | | 11 | 11 |
| PEF, Particulate Emission Factor, $(m^3/kg)$ | | $1.396 \times 10^9$ | $1.316 \times 10^9$ |

## Non-residential Carcinogen Exposure (adulthood only) - ADEQ DRAFT SRLs

10/5/2005

$$C(mg/kg) = \frac{TR \times BW_a \times AT_c}{EF_o \times ED_o \left[\left(\frac{IRS_o \times CSF_o}{10^6 mg/kg}\right) + \left(\frac{SA_a \times AF \times ABS \times CSF_o}{10^6 mg/kg}\right) + \left(\frac{IRA_a \times CSF_i}{VF_s^a}\right)\right]}$$

$$VF_s(m^3/kg) = (Q/C) \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4}(m^2/cm^2)$$

**Chemical-specific Volatilization Factor for volatile chemicals only**

$$PEF(m^3/kg) = Q/C \times \frac{3600 s/h}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

**Particulte Emission Factor (replaces $VF_s$ for non-volatile chemicals)**

| | | **Old Default** | **New Default** |
|---|---|---|---|
| $CSF_o$, Cancer slope factor oral, $(mg/kg\text{-}d)^{-1}$ | | see database | |
| $CSF_i$, Cancer slope factor inhaled $(mg/kg\text{-}d)^{-1}$ | | see database | |
| TR, Target cancer risk | | $10^{-5}$ | $10^{-5}$ |
| $Bw_a$, Body weight - adult, kg | | 70 | 70 |
| $AT_c$, Averaging time for carcinogens, d | | 25,550 | 25,550 |
| $SA_a$, Exposed surface area of adult worker for soil/dust | | **5,000** | **3,300** |
| $AF_a$, Soil Adherence factor - adult worker, $(mg/cm^2)$ | | 0.2 | 0.2 |
| ABS, Skin absorption factor - semi-volatile organics | | 0.1 | 0.1 |
| (unitless) | – volatile organics | **0.1** | **none** |
| | – inorganics | **0.01** | **none** |
| $IRA_a$, Inhalation rate - adult, $(m^3/d)$ | | 20 | 20 |
| $IRS_a$, Soil ingestion - adult, (mg/day) | | **50** | **100** |
| $EF_o$, Exposure frequency - occupational, (d/yr) | | 250 | 250 |
| $ED_o$, Exposure duration - occupational, (years) | | 25 | 25 |
| PEF, Particulate Emission Factor, $(m^3/kg)$ | | $1.396 \times 10^9$ | $1.316 \times 10^9$ |

## Residential Non-carcinogen Exposure (childhood only) - ADEQ DRAFT SRLs

10/5/2005

$$C(mg/kg) = \frac{THQ \times BW_c \times AT_n}{EF_r \times ED_c \left[\left(\frac{1}{RfD_o} \times \frac{IRS_c}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_o} \times \frac{SA_c \times AF \times ABS}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_i} \times \frac{IRA_c}{VF_s^a}\right)\right]}$$

$$VF_s(m^3/kg) = (Q/C) \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4}(m^2/cm^2)$$

**Chemical-specific Volatilization Factor for volatile chemicals only**

$$PEF(m^3/kg) = Q/C \times \frac{3600 s/h}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

**Particulte Emission Factor (replaces $VF_s$ for non-volatile chemicals)**

| | | **Old Default** | **New Default** |
|---|---|---|---|
| $RfD_o$, Reference dose oral, (mg/kg-d) | | see database | |
| $RfD_i$, Reference dose inhaled, (mg/kg-d) | | see database | |
| THQ, Target hazard quotient | | 1 | 1 |
| $BW_c$, Body weight - child, kg | | 15 | 15 |
| $AT_n$, Averaging time for non-carcinogens, d | | $ED_c$ x 365 | $ED_c$ x 365 |
| $SA_c$, Exposed surface area - child | | **2,000** | **2,800** |
| $AF_c$, Soil Adherence factor, child for soil, ($mg/cm^2$) | | 0.2 | 0.2 |
| ABS, Skin absorption factor (unitless) | - semi-volatile organics | 0.1 | 0.1 |
| | – volatile organics | **0.1** | **none** |
| | – inorganics | **0.01** | **none** |
| $IRA_c$, Inhalation rate - child, (m3/d) | | 10 | 10 |
| $IRS_c$, Soil ingestion - child, (mg/day) | | 200 | 200 |
| $EF_r$, Exposure frequency - residential, (d/yr) | | 350 | 350 |
| $ED_c$, Exposure duration - child, (years) | | 6 | 6 |
| PEF, Particulate Emission Factor, ($m^3/kg$) | | $1.396 \times 10^9$ | $1.316 \times 10^9$ |

## Non-residential Non-carcinogen Exposure (adulthood only) - ADEQ DRAFT SRLs

10/5/2005

$$C(mg/kg) = \frac{THQ \times BW_a \times AT_n}{EF_o \times ED_o[(\frac{1}{RfD_o} \times \frac{IRS_o}{10^6 mg/kg}) + (\frac{1}{RfD_o} \times \frac{SA_a \times AF \times ABS}{10^6 mg/kg}) + (\frac{1}{RfD_i} \times \frac{IRA_a}{VF_s^a})]}$$

$$VF_s(m^3/kg) = (Q/C) \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4}(m^2/cm^2)$$

**Chemical-specific Volatilization Factor for volatile chemicals only**

$$PEF(m^3/kg) = Q/C \times \frac{3600 s/h}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

**Particulte Emission Factor (replaces $VF_s$ for non-volatile chemicals)**

| | | **Old Default** | **New Default** |
|---|---|---|---|
| $RfD_o$, Reference dose oral, (mg/kg-d) | | see database | |
| $RfD_i$, Reference dose inhaled, (mg/kg-d) | | see database | |
| THQ, Target hazard quotient | | 1 | 1 |
| $BW_a$, Body weight - adult, kg | | 70 | 70 |
| $AT_n$, Averaging time for non-carcinogens, d | | $ED_o$ x 365 | $ED_o$ x 365 |
| $SA_a$, Exposed surface area of adult workerfor soil/dust | | **5,000** | **3,300** |
| $AF_a$, Soil Adherence factor - adult worker, ($mg/cm^2$) | | 0.2 | 0.2 |
| ABS, Skin absorption factor - semi-volatile organics | | 0.1 | 0.1 |
| (unitless) | – volatile organics | **0.1** | **none** |
| | – inorganics | **0.01** | **none** |
| $IRA_a$, Inhalation rate - adult, ($m^3$/d) | | 20 | 20 |
| $IRS_a$, Soil ingestion - adult, (mg/day) | | **50** | **100** |
| $EF_o$, Exposure frequency - occupational, (d/yr) | | 250 | 250 |
| $ED_o$, Exposure duration - occupational (years) | | 25 | 25 |
| PEF, Particulate Emission Factor, ($m^3$/kg) | | $1.396 \times 10^9$ | $1.316 \times 10^9$ |

# Soil Saturation Limit - ADEQ DRAFT SRLs

10/5/2005

If the level which is protective of health risk or health hazard is greater than the saturation limit, the SRL is the lower value.

## Former Method for Calculation

$$C_{sat+1\%} = \frac{S}{\rho_b}(K_d\rho b + \theta_w + H'\theta_a) + \frac{nn_r\rho_f}{\rho_b}(10^6)$$

## New Method for Calculation

$$C_{sat} = \frac{S}{\rho_b}(K_d\rho b + \theta_w + H'\theta_a)$$

Difference is 1% greater concentration of non-aqueous phase chemical.

| | |
|---|---|
| n, total soil porosity, ($L_{pore}/L_{soil}$) | 0.43 |
| $n_r$, fraction of soil pore space occupied by free phase fluid | 0.01 |
| $\rho_f$, chemical fluid density, ($g/cm^3$) | chemical specific |
| $\rho_b$, soil dry buld density, (kg/L) | 1.5 |